He would therefore spend an additional sum on the pump itself rather than on the purchase of boilers and in stoking, and he might even be sufficiently far-seeing to capitalise the value of the coal he would save, and spend part of that amount also upon the pump.

In conclusion, the opinions expressed by our author to the effect that a pump placed in a chamber underground is for that reason necessarily neglected, and subjected to rough and unskilful treatment, that it cannot be so economical as an engine working on the surface, that steam pipes in the shaft heat the workings, and so on, all tend to betray a want of knowledge of the practice of educated and observant engineers and managers of the present day. They sound rather like an echo from the uninstructed past, or a dirge of the days that are now passing rapidly away. W. GALLOWAY.

## THE PALAEONTOLOGY OF THE INVERTEBRATA.

*Text-Book of Palaeontology.* By Karl A. von Zittel. Translated and edited by Charles R. Eastman, Ph.D. Vol. i. Pp. viii+706; with 1476 woodcuts. (London: Macmillan and Co., Ltd., 1900.)

ENGLISH-SPEAKING geologists and palæontologists have awaited with eagerness the long promised translation of Prof. K. A. von Zittel's well-known "Grundzüge der Palaeontologie" which appeared early in 1895. At last we have received the first volume, which completes half the work, namely, to the end of the Invertebrata. It proves, however, to be much more than a translation of the German original. It is illustrated by the same beautiful woodcuts, with few additions; it is also similar in general plan; but most of the chapters have been entirely rearranged and rewritten, to express the views of the various American and English authors who have co-operated with Dr. Eastman. It is, therefore, virtually a new work, and the scheme of classification adopted is very different from that accepted by the eminent Professor of the University of Munich.

The only part of the "Grundzüge" which remains almost unchanged in the present translation comprises the admirable introductory chapter and the account of the sub-kingdoms Protozoa and Cœlenterata. Here the student will find Prof. von Zittel's own summary of his important researches on the structure and classification of the fossil sponges, which it is well to have left untouched. Changes begin with the Echinodermata, and attain their maximum in the Cephalopod Mollusca, becoming less noteworthy again in the Arthropoda, which conclude the volume.

Of the Echinodermata, the Crinoidea and Blastoidea were revised by the late Charles Wachsmuth. He added much new matter, and described and classified the crinoids in accordance with Wachsmuth and Springer's "Monograph on the Crinoidea Camerata of North America," which is here said to be "as yet unpublished," but really appeared in 1897. The sections on Asterozoa and Echinozoa have been extended, and in some respects much improved, by Mr. Percy Sladen, who has completely rearranged the Euechinoidea in accordance with the researches of the late Martin Duncan. The short description of the Vermes has been revised and slightly enlarged by Dr. G. J. Hinde. The chapter on Bryozoa is no longer that of Prof. von Zittel, but the work of Mr. E. O. Ulrich, who has added many new figures. It is not quite up to date, there being no references to Dr. Gregory's "British Museum Catalogue" or his memoir on early Tertiary Bryozoa, published by the Zoological Society. The Brachiopoda, revised and partly rewritten by Mr. Charles Schuchert, are arranged according to Beecher's classification, which is described in von Zittel's original as "one-sided," being based only on embryology. The rearrangement of the Mollusca has been undertaken by Messrs. Dall, Pilsbry and Hyatt, who deal respectively with the Pelecypoda, Gastropoda and Cephalopoda. Here it is difficult to recognise any of the original "Grundzüge" except the figures. In the description of the Arthropoda, Prof. Charles E. Beecher has added much important new matter to the section on Trilobita, which students will be glad to have. The treatment of the higher Crustacea and Merostomata is also much changed by the revision of Profs. Clarke and Kingsley; but the Arachnida, Myriopoda and Insecta, edited by Mr. Scudder, remain almost as in the original German work.

With so many collaborators, it has naturally been impossible for Dr. Eastman to obtain uniformity of style throughout the volume; and the judgment which teachers and original workers will pass upon it depends largely on the section which they happen to consult. On the whole, we are disposed to prefer the original volume in the form in which it was issued by the distinguished teacher who prepared it. With all due deference to the eminent specialists who have devoted so much labour to the translation and revision, we cannot refrain from expressing our opinion that they have converted an admirable student's manual into little more than an index to certain technical memoirs, which are as yet by no means accepted classics in palæontology. As Prof. von Zittel himself remarks in his preface, many of these memoirs are founded on certain embryological and phylogenetic considerations, which may soon prove to be baseless assumptions; while the old methods of comparative anatomy are often almost abandoned in favour of some one-sided hypothesis. We would also note that a large proportion of the generic names adopted are quite unknown in the original works on geology and palæontology which the average student will have to consult at the beginning of his career. In short, if the translators and revisers had devoted more attention to the correction of errors or the incorporation of new facts, and displayed less eagerness to infuse their own personal idiosyncrasies into the work, they would have done much more valuable service than they have actually accomplished.

The subject is too technical to enter into detailed criticism, and it must suffice merely to allude to three points in illustration of the difficulties which are placed in the way of the student.

One of the first fossils which every student must learn to know is the brachiopod *Terebratula*. Accordingly, Prof. von Zittel, in his "Grundzüge," gives a concise

description of this shell as ordinarily understood in standard literature. Mr. Schuchert's translation, on the other hand, has :—"*Terebratula*, Klein, 1753 (Fig. 551). Genus not well known. Mesozoic or Tertiary." He merely gives a list of ill defined generic names of no value whatever, except as an index to certain special memoirs which he happens to approve.

In the Mollusca Pelecypoda, Dr. Dall must have devoted great labour to his exhaustive revision; but, from the student's point of view, it would have been much better if he had bestowed it on the correction of mistakes. In the description of *Pseudomonotis*, for example, "left valve" is copied from the original German, although even the accompanying figure must have shown the translator that it was a mistake for "right valve."

Finally, every student must know something of the common *Nautilus*. If he looks at Prof. Hyatt's description (p. 526), he will learn that it is a recent genus, and may perhaps range backwards to the Tertiary; but if he turns to Figs. 1075 and 1076, he will read that species of the genus occur in the Middle Lias and the Tithonian. Which of these two contradictory statements does Prof. Hyatt intend the unfortunate student to accept? We presume he intended to re-name the illustrations *Cenoceras*, and, like Dr. Dall, was too much occupied with the greater rearrangements to take note of the minute points on which the real value of a text-book depends. In fact, not only in this instance, but throughout Prof. Hyatt's section on Cephalopoda, the student will find hopeless confusion and receive practically no aid in plodding through the current literature of geology and palæontology. Nearly a hundred new generic names, introduced without definition, add in no small degree to the difficulties.

While, however, the elementary student, for whom the "Grundzüge" was written, will meet with disappointment when he attempts to use its English counterpart, the more advanced student engaged in original research will welcome the handsome volume which Dr. Eastman has produced. It is a valuable work of reference, which ought to find a place in every geological and biological library. We hope it will soon be followed by the second volume, containing the Vertebrata, which will make the English "Zittel" the most exhaustive and valuable treatise on palæontology in our language.

## *INADEQUACY OF THE CELL-THEORY.*

*Les Êtres Vivants. Organisation—Evolution.* By Paul Busquet. Pp. 181; 141 figures. (Paris: Carré and Naud, 1899.)

WHAT the particular secret of this volume is, we have been unable to discover, except that it is intended as an argument for a franker recognition of the unity of the organism, and as an argument against the view which regards the multicellular creature as a "cell-state" or as a colony. To discuss these difficult matters profitably requires great competence, and we do not think that this is shown by the author, who, for instance, cites the old report that the ectoderm of a Hydra turned inside out becomes endoderm, and so on, and uses this as an argument against the original distinctiveness of the two germinal layers. Furthermore, while an attack on a position often means progress, one must master the previous moves, and we see no evidence that Dr. Busquet has done so. Has he seriously considered, for instance, Whitman's notable essay on "The Inadequacy of the Cell-Theory of Development"?

A pleasing feature of the book is the author's grateful tribute to his master, Prof. Kunstler, whose views he expounds and elaborates. Thus he begins with a defence of Kunstler's conclusion that protoplasm is composed of series of minute elements, more or less globular, either placed in apposition or separated by fluid. This alveolar or "spherular" structure of protoplasm was described by Kunstler in 1881, and has been familiarised by the researches of Bütschli (not Butschli, as the author persistently calls him, just as he calls Kölliker--Kolliker, which is absurd). We do not notice any mention of Flemming, though his lifelong observations on reticular structure, and his criticism of the demonstrations of alveolar structure, must be taken account of if one wishes to be treated seriously in discussing such matters.

The author points out that just as Dutrochet (1824) and Turpin (1826) may be said to have priority over Schwann and Schleiden in formulating the "Cell-Theory," so Kunstler must be credited with priority over Sedgwick, Whitman and Delage in demonstrating its inadequacy. For Kunstler maintained long ago that the cell is no primitive morphological unit, but an acquired mode of organisation, and that the cellular structure of the Metazoa is a secondary result adaptive to functional convenience. The frequent vagueness of cell-limits, the abundant illustrations of inter-cellular bridges, and the occurrence of indisputable syncytia are forcibly indicated by the author.

It is argued that to think of a Metazoon as derivable from a colony of Protozoa is misleading; and that although there are some true colonies among Metazoa, *e.g.* in Cœlenterates and Tunicates, the colonial or polyzoic hypothesis, especially elaborated by Perrier, is a specious fallacy. We are asked to choose between two alternatives—the Metazoa are colonies of individualities of a lower order, or they are individualised irreducible unities. But it is not made plain why we may not suppose that the ancestral forms of various stocks passed through an imperfectly integrated colonial or polyzoic stage.

The author takes a survey of the animal kingdom, and seeks to substantiate a number of general conclusions, which we shall try to summarise. Living matter shows "a general and universal tendency to proliferation or repetition of similar parts." "These phenomena of repetition appear at first in the adult, where they constitute an acquired character; in the embryo they are but the reproduction more or less modified, by coenogeny, of what exists in the perfect individual." But in certain circumstances the repeated parts may coalesce, exhibiting a secondary and acquired simplification, and bringing about a recondensation of the organism, preparatory to a recommencement of the evolutionary process on some new line. Types do not arise by a slow and direct transformation of pre-existing forms, but each is a new